The Effect Of Different Preparation Designs & Cement Type On The Marginal Adaptation Of All-Ceramic Cantilever Anterior Fixed Partial Dentures

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Introduction

The interest of dental research in metal-free restorations has been rising in the last 20 years following the introduction of innovative all-ceramic materials in the daily practice. In particular, high strength ceramics and related CAD/CAM techniques have widely increased the clinical indications of metal-free prostheses, showing more favorable mechanical characteristics compared to the early ceramic materials.

Zirconia is one of the most promising restorative materials, because it yields very favorable mechanical properties and reasonable esthetic. Several in vitro and in vivo investigations reported suitable strength and mechanical performances of zirconia, compatible with clinical serviceability as a framework material for both single crowns and short-span fixed partial dentures.

The use of zirconia frameworks for fixed-fixed partial dentures or for Cantilevered restorations is currently under evaluation and further in vivo, long-term clinical studies will be needed to provide scientific evidence for drawing solid guidelines.

Cantilever fixed partial dentures are defined as having one or more abutments at one end of the prosthesis while the other end is unsupported. Much controversy without documentary evidence has surrounded this prosthesis. Despite negative arguments, the cantilever prosthesis has been used extensively by the clinicians. If used no judiciously without following proper guidelines these might lead to some complications. Although complications may be an indication that clinical failure has occurred, this is not typically the case. It is also possible that complications may reflect substandard care. There are various criteria and factors necessary for a successful cantilever fixed partial denture (FPD).

The purpose of the study is to evaluate the effect of the abutment preparations and the type of cement used on marginal adaptation of all ceramic anterior cantilever fixed partial dentures.

Review of literature

Dental ceramics may be defined as an inorganic compound with non-metallic properties consisting of oxygen and one or more metallic or semi-metallic elements, e.g. aluminum, magnesium, silicon, titanium and zirconium. [1, 2] They may exist as either crystalline or amorphous solids, being called glasses. [3]

Many types of ceramic materials and processing techniques have been introduced throughout the years. As early as 1903, Charles Land patented all-ceramic restorations, using fired porcelains for inlays, onlays, and crowns.[4] Insufficient understanding about material requirements for survival in the oral environment, poor ceramic processing techniques, and the inability for adhesive cementation led to early catastrophic failure. Since then, all imaginable varieties of materials and techniques from very conservative ceramic restorations to very complex porcelain veneered of either metal or high-strength crystalline ceramics have been introduced and tried with varying levels of success.[5] The authors have previously published two detailed descriptions, or classification systems, for ceramics used in dentistry—one based on the microstructure of the material and the second on how the material is processed.[6]

Before making any decision regarding the use of a material or technique, a dental practitioner must have a treatment philosophy based on current standards of care that consider the patient's esthetic requirements. More importantly, this philosophy should be aimed at maintaining the long-term biologic and structural health of the patient in the least destructive way.

Restorative or esthetic dentistry should be practiced as conservatively as possible. The use of adhesive technologies makes it possible to preserve as much tooth structure as feasible while satisfying the patient's restorative needs and esthetic desires.[7] The philosophy today is not to remove any healthy tooth structure unless absolutely necessary. Our goal would be to not remove excessive amounts of enamel and expose the dentin when orthodontics would have been the ideal treatment. With restorations, clinicians should choose a material and technique that allows the most conservative treatment in order to satisfy the patient's esthetic, structural, and biologic requirements and has the mechanical requirements to provide clinical durability.

Classification of dental ceramics:

Many different ceramics have been introduced in recent years for all types of indirect restorations. Knowing the various types of materials and processing techniques is a must for every clinician in order to choose the right material and processing technique for every patient.[8]

Ceramics can be classified into :

There are four broad categories, or types of ceramic systems, from which to choose:

Category 1: powder/liquid feldspathic porcelains;

Category 2: pressed or machined glass-ceramics;

Category 3: high-strength crystalline ceramics; and

Category 4: metal-ceramics.

Category 1 (porcelains)—are the most esthetic, especially in thin sections and thus can be used the most conservatively, but are the weakest.(9-10)

Category 2 (glass-ceramics) also can be very translucent but requires slightly thicker dimensions for workability and esthetics than Category 1.

Although demonstrating progressively higher fracture resistance, **Categories 3 and 4** are more opaque and therefore, require additional tooth reduction that produces a less conservative alternative.

Based on the treatment goal of being as conservative as possible, the first choice will always be porcelains, then glass-ceramics, followed by high-strength ceramics or metalceramics. The decision will be based on satisfying all the treatment requirements, ie, if the more conservative material can meet all the treatment requirements, then that is the ideal choice.

Zirconia:

In the search for the ultimate esthetic restorative material, many new all-ceramic systems have been introduced to the market[11,12]; the use of all ceramic materials is increasing at almost an exponential rate. Ceramics offer the potential for excellent esthetics, biocompatibility, and long-term stability.[11,12]

One material currently of great interest is zirconia. Zirconia is the strongest and toughest ceramic material available for use in dentistry today.[13] Zirconia has the potential to allow for the use of reliable, multiunit all-ceramic restorations for high-stress areas, such as the posterior region of the mouth.

Although still too new to have generated 5- and 10-year studies, in 2 years of using zirconia frameworks for single crowns and some short fixed partial dentures (FPD) at the UCLA School of Dentistry and Boston University, the authors have yet to encounter a single failure. Three-year data from studies in Germany and Switzerland, where zirconium-core technology was developed, are now emerging; these report no fractures of the zirconia frameworks.[14]

Zirconia frameworks are available from several computer-aided design/manufacturing (CAD/CAM) systems, such as Vita YZ from CEREC inLab (Sirona, Bensheim, Germany), Lava (3M/ESPE, Seefeld, Germany), Cercon (Dentsply/Degussa, York, PA, USA), and Procera Zirkon (Nobel Biocare, Göteborg, Sweden). In addition to new framework materials, veneering porcelains are being engineered with fine microstructures to improve the clinical benefits for the patient. Concomitantly, the microstructures create improved optical properties that more closely mimic the properties of natural teeth .

The understanding of color science relative to teeth has improved in recent years, as some manufacturers have improved shading to be able to more closely replicate the shades of natural teeth.[15]

Zirconia (ZrO_2) is an oxidized form of the zirconium metal. Zirconia may exist in several crystal types (phases), depending on the addition of minor components such as calcia (CaO), magnesia (MgO), yttria (Y_2O_3), or ceria (CeO_2). These phases are said to be stabilized at room temperature by the minor components. If the right amount of component is added, one can produce a fully stabilized cubic phase—the infamous cubic zirconia jewelry. If smaller amounts are added, 3 wt% to 5 wt%, a partially stabilized zirconia is produced. The tetragonal zirconia phase is stabilized, but under stress, the phase may change to monoclinic, with a subsequent 3% volumetric size increase. This dimensional change takes energy away from the crack and can stop it in its tracks. This is called “transformation toughening” . Also, the volume change creates compressive stress around the particle, which further inhibits crack growth.